# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2 Exhibit)

**June 2001**

BUDGET ACTIVITY
**3 - ADV TECHNOLOGY DEV**

PE NUMBER AND TITLE
**0603004A - Weapons and Munitions Advanced Technology**

| COST (In Thousands) | | FY 2000 Actual | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Program Element (PE) Cost | | 54526 | 55227 | 29684 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 232 | ADVANCED MUNITIONS DEM | 15723 | 18537 | 29684 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 244 | WARHEAD AND ENERGETICS CENTER OF EXCELLENCE | 4773 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 43A | ADV WEAPONRY TECH DEMO | 34030 | 36690 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| L94 | ELECTRIC GUN SYS DEMO | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**A. Mission Description and Budget Item Justification:**

**PLEASE NOTE: This administration has not addressed FY2003-2007 requirements. All FY 2003-2007 budget estimates included in this book are notional only and subject to change.**

This Program Element (PE) demonstrates affordable, smaller and/or lighter advanced weapons and munitions technologies to increase battlefield lethality and survivability for the Future Combat Systems (FCS) and the Objective Force. Specific efforts include: FCS Multi-Role Armament and Ammunition; Direct Fire Lethality (DFL) Program; Tank Extended Range Munition (TERM); Precision Guided Mortar Munition (PGMM); and Responsive Accurate Mission Module (RAMM). The FCS Multi-Role Armament utilizes electrothermal-chemical (ETC) propulsion and provides a single armament module configuration supporting both maneuver and fire support missions. The corresponding FCS Multi-Role Ammunition, a three-cartridge suite, provides overwhelming lethality at ranges up to 50 kilometers with greater precision and accuracy and reduced logistics footprint for the Objective Force. In the area of combat vehicle anti-armor munitions, advanced explosively formed penetrator (EFP) warheads exploit technologies in explosives, liner materials and modeling, and demonstrate increased armor penetration through advanced warhead concepts. This program adheres to Tri-Service Reliance Agreements on conventional air-surface weaponry with oversight provided by the Joint Directors of Laboratories. Work in this PE is related to and fully coordinated with efforts in PE 0602624A (Weapons and Munitions Technology), PE 0602618A (Ballistics Tech) and PE 0604802A (Weapons and Munitions - Engineering Development). The cited work is consistent with the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan and Project Reliance. The program element contains no duplication with any effort within the Military Departments. Work is performed by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey.

| **B. Program Change Summary** | FY 2000 | FY 2001 | FY 2002 | FY 2003 |
|---|---|---|---|---|
| Previous President's Budget (FY2001 PB) | 58042 | 29738 | 12201 | 0 |
| Appropriated Value | 58643 | 55738 | 0 | |
| Adjustments to Appropriated Value | 0 | 0 | 0 | |
| a. Congressional General Reductions | 0 | 0 | 0 | |
| b. SBIR/STTR | -1355 | 0 | 0 | |
| c. Omnibus or Other Above Threshold Reductions | -208 | 0 | 0 | |
| d. Below Threshold Reprogramming | -2161 | 0 | 0 | |
| e. Rescissions | -393 | -511 | 0 | |
| Adjustments to Budget Years Since FY2001 PB | 0 | 0 | 17483 | |
| Current Budget Submit (FY 2002/2003 PB ) | 54526 | 55227 | 29684 | 0 |

Change Summary Explanation: Funding - FY 2001: Congressional adds were received for Multi-role FCS Armaments (+10000), Precision Guided Mortar Munition (+6000), Viking Indirect Fire Module (+5000) and SMAW-D Concept Demo Testing (+5000).

FY 2002/2003 (+12483) funding was increased for Multi-role FCS Armament in support of Army transformation and (+5000) to support time critical, standoff, and concealed target defeat (Project 232).

# ARMY RDT&E BUDGET ITEM JUSTIFICATION (R-2A Exhibit)

**June 2001**

| BUDGET ACTIVITY | PE NUMBER AND TITLE | PROJECT |
|---|---|---|
| **3 - ADV TECHNOLOGY DEV** | **0603004A - Weapons and Munitions Advanced Technology** | **232** |

| COST (In Thousands) | FY 2000 Actual | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|
| 232 ADVANCED MUNITIONS DEM | 15723 | 18537 | 29684 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**A. Mission Description and Budget Item Justification:** This project demonstrates munition enhancements for the Objective Force and the FCS Multi-Role Armament and Ammunition, as well as emerging technologies in lightweight structures, smart materials and in-flight update architectures. This project includes the DFL program which will enhance kinetic energy (KE) penetrator lethality against explosive reactive armor (ERA) appliqué arrays now available on fielded threat systems, through use of a novel penetrator defeat mechanism. TERM will evaluate warhead designs versus range targets. RAMM lightweight mortar concept suitable for insertion into a generic FCS platform will be developed. A Congressionally funded effort to perform feasibility studies adapting the Shoulder-Launched Multipurpose Assault Weapon-Confined Space (SMAW-CS) to the Bunker Defeat Munition will be completed. In-house efforts are accomplished by Armament Research Development and Engineering Center (ARDEC), Picatinny Arsenal, New Jersey and the Army Research Laboratory, Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp., McLean, VA; LTV Aerospace, Dallas, TX; Textron Defense Systems, Wilmington, MA; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; PRIMEX-Flinchbaugh, Red Lion, PA; Alliant Tech Systems-Allegheny Ballistics Laboratory, Rocket City MD and Raytheon/TI Systems, Tucson, AZ. This program supports the Objective transition path of the Transformation Force Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 6315 Completed extended range novel KE penetrator flight functional tests; completed integrated cartridge design for FY 2001 Advanced Technology Demonstration (ATD) of 50%+ increase in armor penetration over 120mm M829A2.
- 7488 Completed development of TERM multi-sensor technologies that have applicability to smaller, lighter armaments for the FCS; conducted captive flight test (CFT) verification of sensor technology.
- 1920 Completed one-year Congressionally directed program, which conducted multi-role cannon armament system turret design studies for FCS; successfully demonstrated potential of 70% reduction in cannon recoil forces.

Total 15723

**FY 2001 Planned Program**

- 6500 Demonstrate advanced KE munition novel penetrator defeat against ERA with an increase in penetration of at least 50% over the M829A2 at extended range; demonstrate feasibility of minimum 30% increase in system accuracy (probability of hit) with radial thruster technology on KE penetrators.
- 6705 Complete TERM warhead design and analysis; conduct warhead testing versus range targets; perform ballistic test firings of the TERM propulsion system over the temperature ranges; update tactical seeker design; transfer design and technology to Multi Purpose-Extended Range Munition for FCS.
- 4807 The purpose of this one year Congressional add is to conduct a feasibility study adapting SMAW-CS to Bunker Defeat Munition; conduct modeling and simulation and limited test and evaluation of prototype hardware.
- 525 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 18537

**FY 2002 Planned Program**

- 5924 Conduct airframe and lethality demonstrations for Multi-Purpose Extended Range Munition (MP-ERM).
- 1760 Complete design and initiate fabrication of medium caliber air bursting projectile; conduct medium caliber novel kinetic energy penetrator testing against advanced armors.
- 17000 Complete the following for the FCS Multi-Role Armament: Fabricate and conduct functional test of lightweight, low impulse multi-role cannon for FCS; fabrication of automated ammunition handling system and load/unload function testing with multi-role cannon; demonstrate Best Technical Approaches for electrothermal-chemical (ETC) propellant with increased energy and lower sensitivity; complete fire control software development, hardware integration, and conduct preliminary System Integration Laboratory Prove-out.
- 5000 Complete Multi-Role Smart Cargo projectile design to include guidance and control; demonstrate best technical approaches for dynamic retargeting to locate and defeat time critical targets; demonstrate by modeling and simulation, maximized payload volume using smart materials, structures and metal matrix composites for airframe.

Total 29684

| COST (In Thousands) | | FY 2000 Actual | FY 2001 Estimate | FY 2002 Estimate | FY 2003 Estimate | FY 2004 Estimate | FY 2005 Estimate | FY 2006 Estimate | FY 2007 Estimate | Cost to Complete | Total Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 43A | ADV WEAPONRY TECH DEMO | 34030 | 36690 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**A. Mission Description and Budget Item Justification:** This project demonstrates system and lethality enhancements to support the Objective Force and the FCS Multi-Role Armament and Ammunition. Included are Captive Flight Tests (CFT) to validate TERM sensor concepts; high-G and live fire testing of the PGMM; completion of Electro-Rheological fluid characterization; conduct integration testing of advanced penetrators with composite sabots to support the FCS ammunition; and completion of Congressionally funded program to evaluate 120mm mortar, one-tenth training round. This project will demonstrate a single compact armament mission module configuration for the FCS Multi-Role Armament, an ETC system suitable for a lightweight combat vehicle to support maneuver and fire support missions. It will explore automation, recoil mitigation and weight reduction technologies to achieve maximum mission flexibility. Efforts on the corresponding FCS Multi-role Ammunition will develop next generation ETC propellant and MP-ERM. In-house efforts are accomplished by Armament Research Development and Engineering Center (ARDEC), Picatinny Arsenal, NJ and the U.S. Army Research Laboratory (ARL), Aberdeen Proving Ground, MD. Major contractors include: Alliant Tech Systems, Minneapolis, MN; Science Applications International Corp. (SAIC), McLean, VA; LTV Aerospace, Dallas, TX; Textron, Lowell, MA; Talley Defense, Mesa, AZ; Parker Kinetics Design, Austin, TX; Nomura Enterprise, Rock Island, IL; Loral, Dallas, TX; PRIMEX-Flinchbaugh, Red Lion, PA; Textron, Inc., Willington, MA; Technical Solutions Incorporated (TSI), Mesina Park, NM; Motorola, Scottsdale, AZ; Lockheed Martin, Orlando, FL; MEI Technology, Lexington, MA; Computing Device International, Minneapolis, MN; Singer Kearfott, Wayne, NJ; Diehl GmbH., Rothenbach, Germany; Design Systems Technologies Inc. (DSTI), Rockville, MD, Alliant Tech Systems, Allegheny Ballistics Laboratory, Rocket City MD, Raytheon/TI Systems, Tucson, AZ. This program supports the Objective Force transition path of the Transformation Campaign Plan (TCP).

**FY 2000 Accomplishments**

- 9694 Conducted sensor demonstrations of TERM concepts using simulation and CFT to validate sensor footprint and acquisition capabilities to support extended range precision engagements out to 8 kilometers; defined TERM fire control system and munition concept design; transfer design and technology to MP-ERM for FCS.
- 6163 Conducted PGMM system high-G tests via parachute round firings; conducted wind tunnel tests; conducted flight integrity live fire tests; completed gyroscope integration; conducted simulation and modeling effort for area denial.
- 4791 Completed one year Congressionally directed program which isolated the root cause of PGMM sluggish fin opening times and designed/tested new fin assembly (Root cause successfully identified and new fin design successfully functioning in live fire tests.); Performed constructive simulations using Training and Doctrine Command (TRADOC) Analysis Center (TRAC) certified vignette experiments; isolated gyro drift error sources; redesigned and validated fixes to gyro subsystem via railgun testing; completed laser seeker design and began component testing.

**FY 2000 Accomplishments (Continued)**

- 4866 Completed fabrication of the future direct support weapon system demonstrator, and initiated requirements analyses to determine suitability of related technologies for incorporation into the FCS Multi-Role Armament.
- 4791 Completed one year Congressionally directed program which completed electro-rheological (ER) fluid research including fluid characterization, software control methodology, materials and structures modeling, and power supply design.
- 2042 Conducted integrated demonstrations of novel dual penetrator systems to establish enhanced defeat of complex armor with less than five megajoules of energy on target.
- 725 Completed one year Congressionally directed program to select and test two candidate approaches for low cost microchip lasers suitable for laser rangefinders.
- 958 Completed one year Congressionally directed program, which procured and evaluated prototype quantities of 120mm, one-tenth range training rounds to verify performance and reusability.

Total 34030

**FY 2001 Planned Program**

- 2000 Complete CFT of TERM sensor technologies; conduct subsystem technology demonstrations of TERM concepts including warhead, propulsion and high-G testing; update system designs and complete design transfer to MP-ERM for FCS.
- 1447 Complete demonstrations of candidate medium caliber non-depleted uranium (DU) novel kinetic energy penetrator for evaluation of increased behind armor effects; complete design of medium caliber air bursting warheads for application to FCS.
- 4899 Conduct flight integrity live fire tests, hardware in-the-loop simulations and perform PGMM Advanced Technology Demonstration (ATD) laser round demonstration firings; build and test area denial hardware and conduct system demonstration.
- 5819 This one year Congressional add for PGMM supports these efforts: perform live fire test of prototype, 3-axis gyro subsystem; perform wing deployment test of system high-G rounds; perform live fire test of prototype seeker subsystem.
- 14551 The purpose of this one year Congressional add is to complete the following in support of the FCS Multi-Role Armament and Ammunition; Design and initiate fabrication of lightweight cannon for Multi-Role Armament; fabricate test hardware and validate, via firings, multi-role cannon chamber and ammunition cartridge case functionality; complete design of automated ammunition handling system; initiate turret design studies for best technical approach for single armament module for maneuver and fire support applications.

**FY 2001 Planned Program (Continued)**

- 4902 Complete the following in support of the FCS Multi-Role Armament: Complete development of candidate Generation II ETC propellant formulations for 25% increased energy (performance) with equal sensitivity to current tank ammunition; initiate design concept study of MP-ERM with precision defeat capability out to 10 kilometers against high value point targets.
- 2000 Conduct integration testing of advanced penetrator designs and composite sabots.
- 1072 Small Business Innovation Research/Small Business Technology Transfer (SBIR/STTR) Programs.

Total 36690

**FY 2002 Planned Program**

Project not funded in FY 2002.